(12) UK Patent Application (19) GB (11) 2 372 136 (13) A

(43) Date of A Publication 14.08.2002

(21) Application No 0103511.2

(22) Date of Filing 13.02.2001

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(51) INT CL[7]
F21V 9/10

(52) UK CL (Edition T)
G5C CDBK
F4R RFG R336 R417

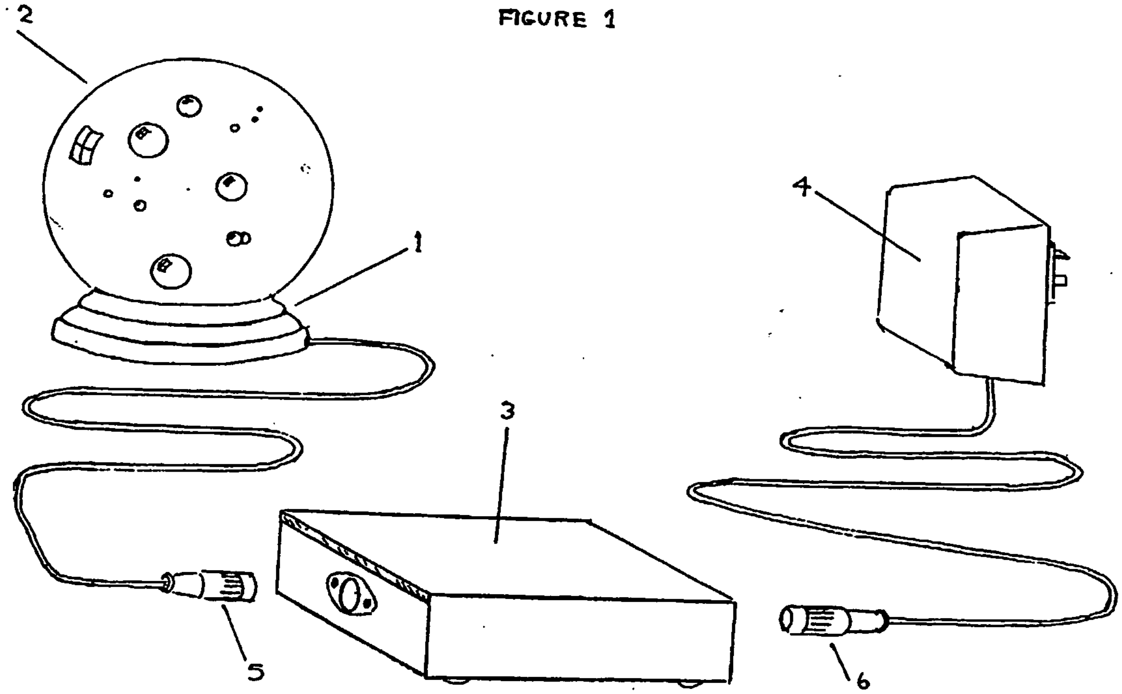
(56) Documents Cited
EP 0822371 A2
US 3789211 A
WO 1999/013693 A1

(58) Field of Search
UK CL (Edition S) F4R RFC RFG , G5C CDBK CDBX
INT CL[7] F21K 7/00 , F21V 9/10
Online: WPI, EPODOC, PAJ

(54) Abstract Title
Random coloured light production

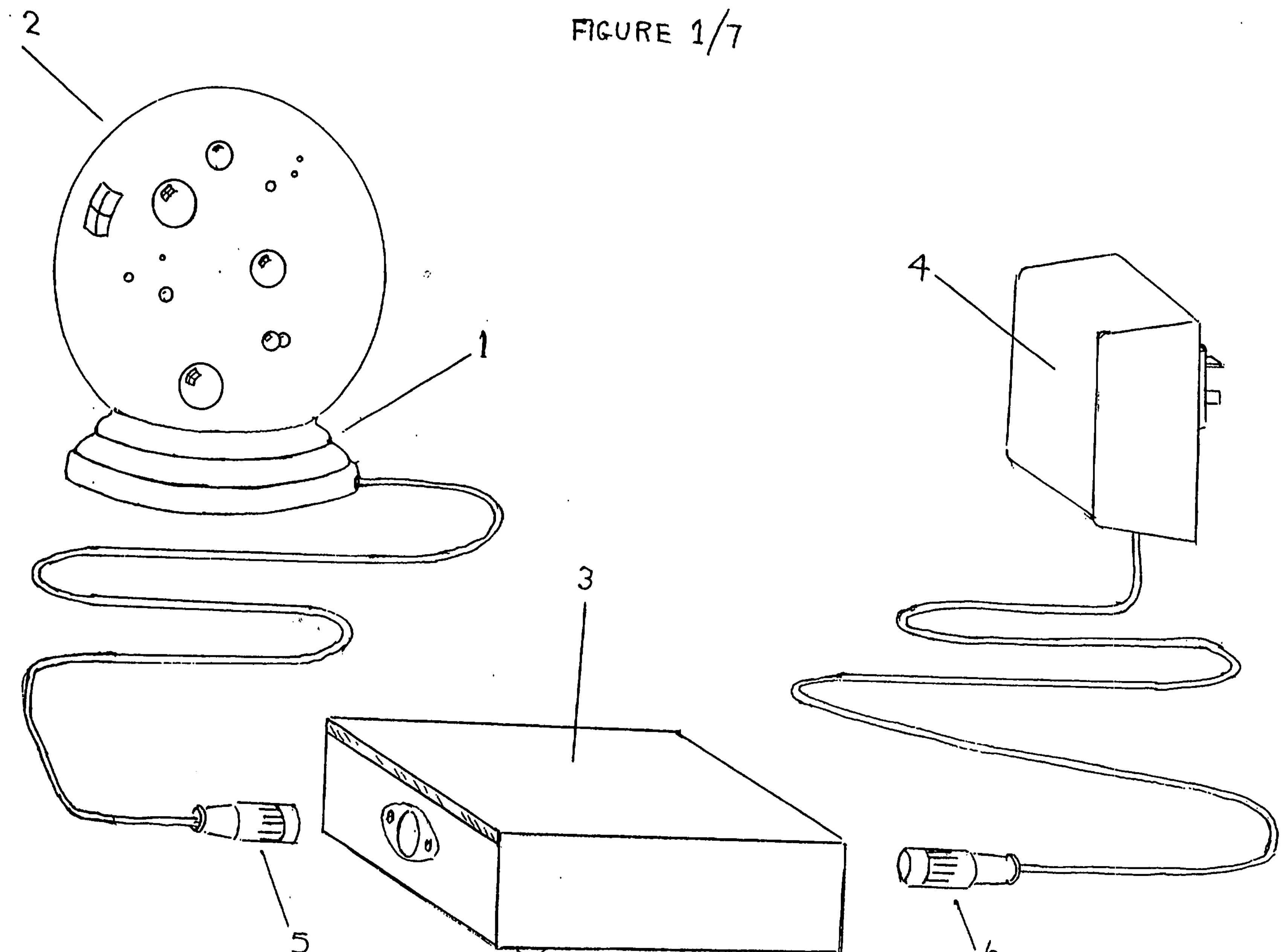
(57) Electronic circuitry (Figs 3, 4, 5, 6) is used to randomly and independently change the intensity of red, green, and blue light sources to create all the colours of the spectrum. The light sources can be incandescent or halogen lamps covered with filters, or red, green and blue light emitting diodes. The random voltages may be derived digitally or from electronic noise circuits, and may vary slowly or quickly. An embodiment of the invention is a glass globe 2, containing minute bubbles or filagree of small white particles in order to mix the light, placed on a stand 1 which houses a group of LEDs that emit red, green and blue light. Enclosure 3 carries the electronic circuitry for generating the random voltages. Alternatively, a glass cylinder or vase can be us d instead of the globe and filled with glass marbles to create a similar effect. If buildings are to be illuminated, a triac or tyristor interface circuit would be required (Fig 6) to drive the lamps, and stepper motors could connected to the random voltage generators to move the lamps in a random manner.

FIGURE 1



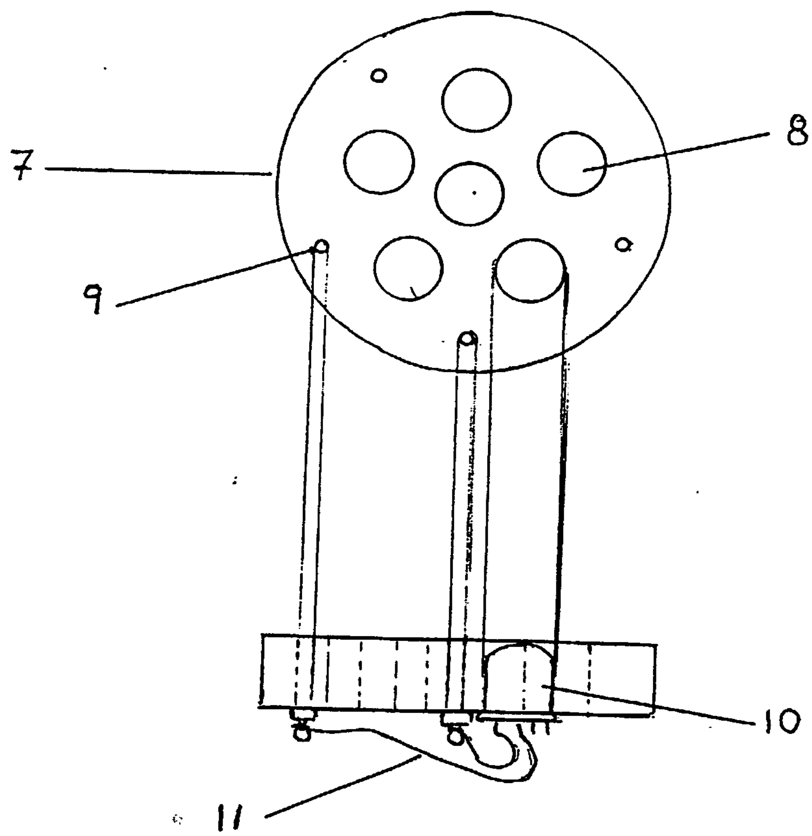
GB 2 372 136

FIGURE 1/7



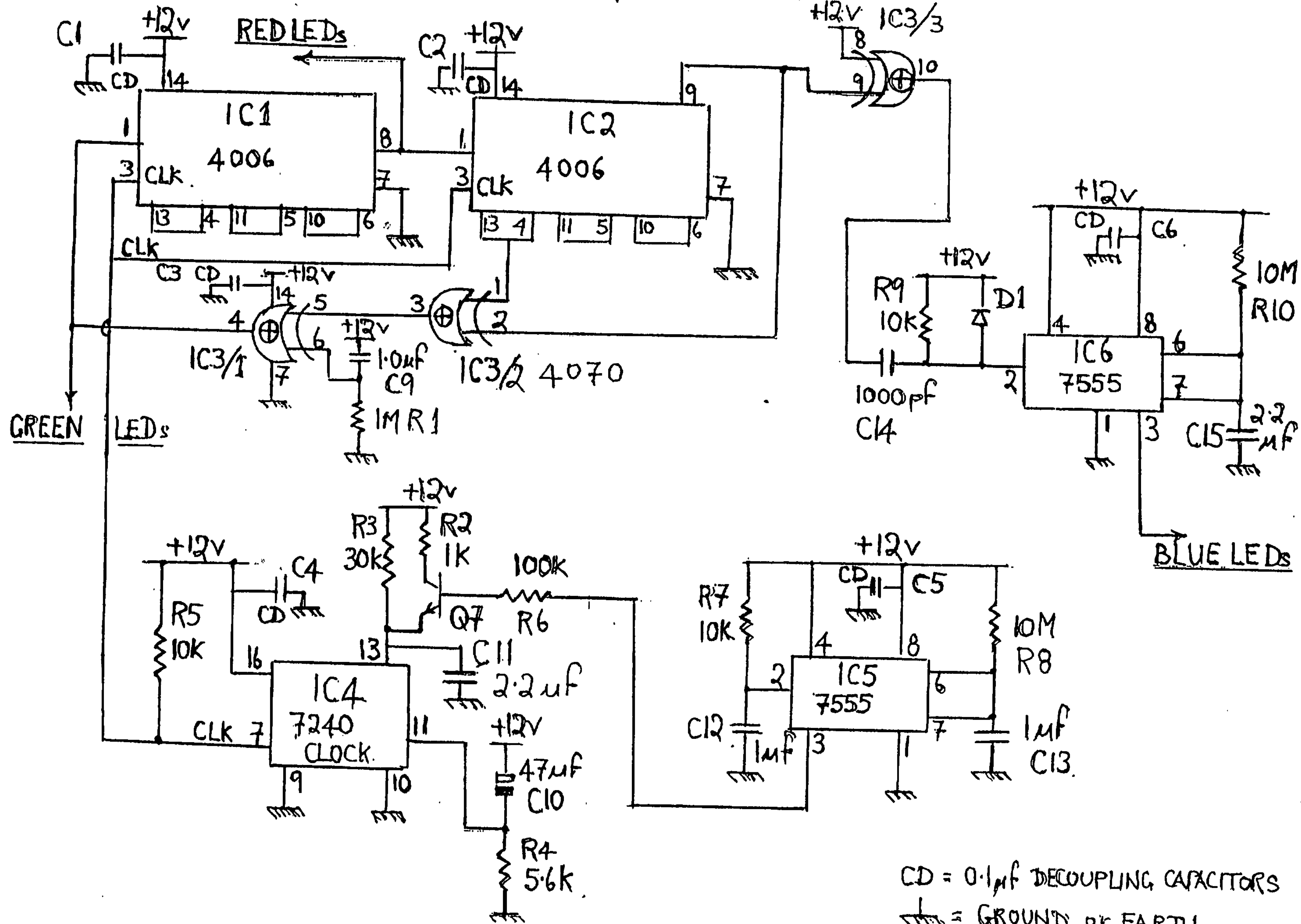
½ SCALE

FIGURE 2/7



FULL SCALE

FIGURE 3/7



CD = 0.1μf DECOUPLING CAPACITORS

= GROUND or EARTH

Q7 = BC109

FIGURE 4/7

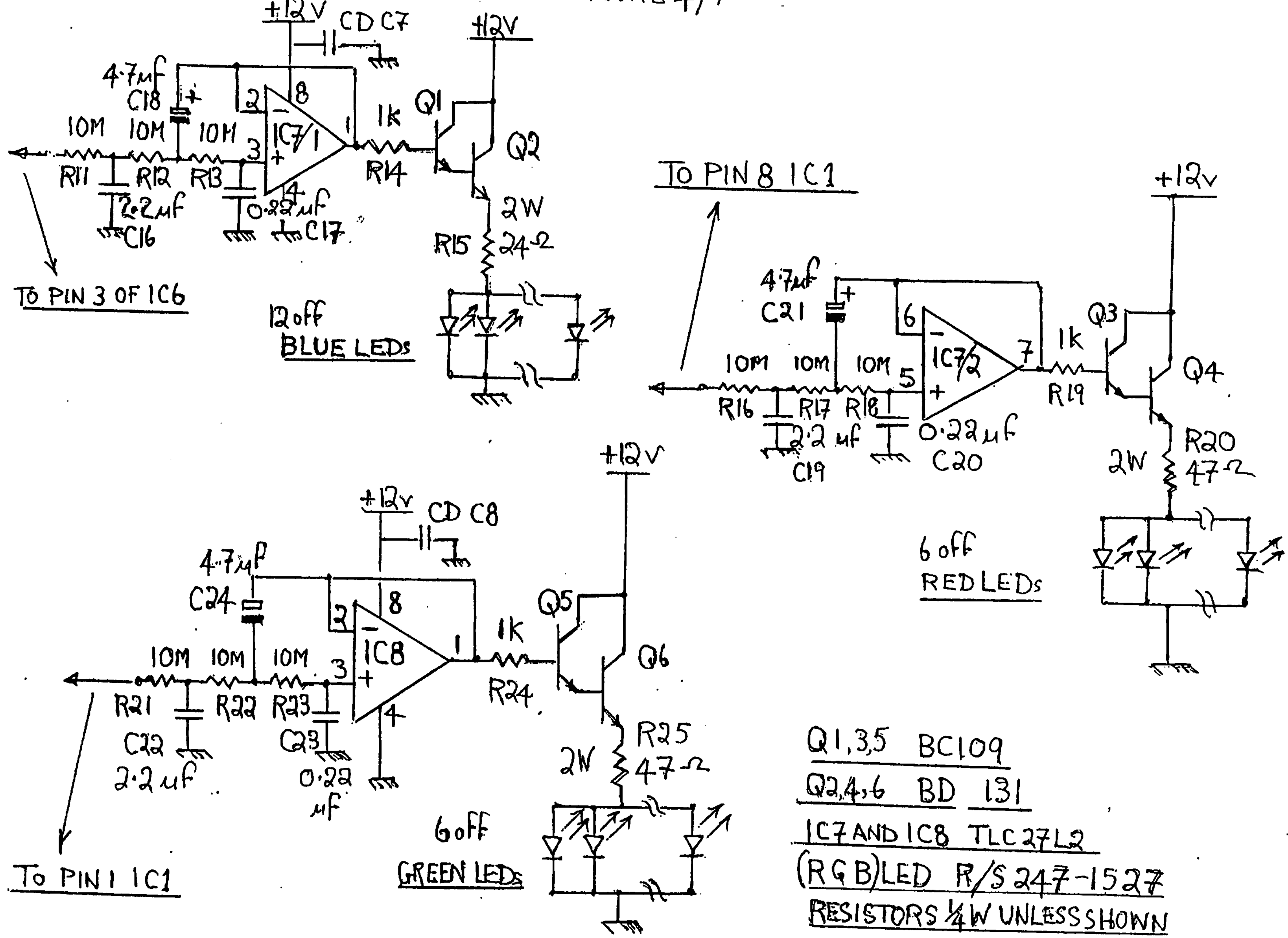
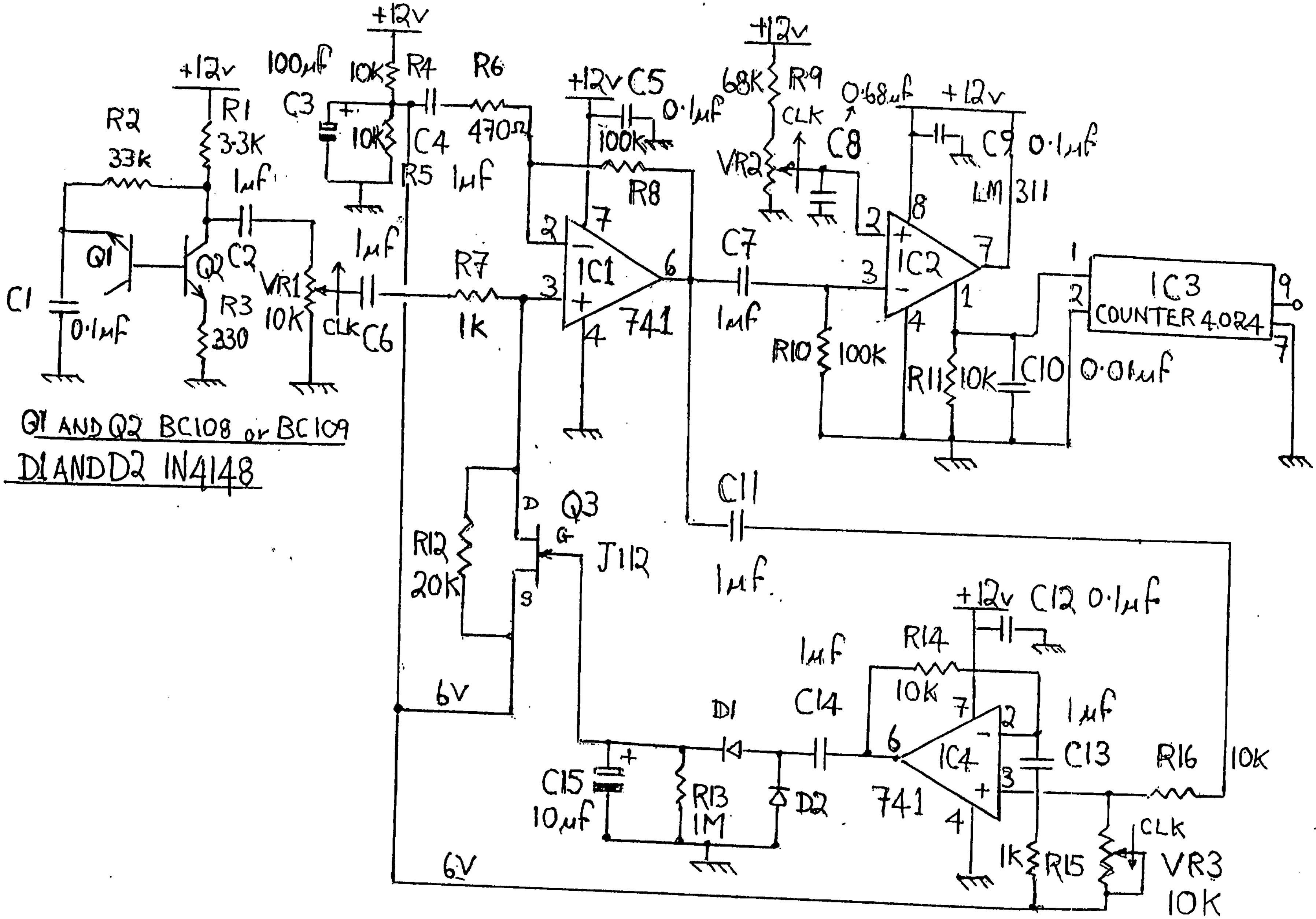

+12V
CD C7
4·7μf
C18
10M
10M
10M
R11
R12
R13
2·2μf
C16
0·22μf
C17
IC7/1
1k
R14
Q1
Q2
+12V
2W
R15
24Ω
TO PIN 3 OF IC6
12 off
BLUE LEDs
TO PIN 8 IC1
+12v
4·7μf
C21
10M
10M
10M
R16
R17
R18
2·2 μf
C19
IC7/2
0·22μf
C20
1k
R19
Q3
Q4
R20
2W
47Ω
6 off
RED LEDs
+12v
CD C8
+12v
4·7μF
C24
10M
10M
10M
R21
R22
R23
C22
2·2μf
C23
0·22 μf
IC8
1k
R24
Q5
Q6
R25
2W
47Ω
6 off
GREEN LEDs
TO PIN 1 IC1
Q1,3,5 BC109
Q2,4,6 BD 131
IC7 AND IC8 TLC27L2
(RGB)LED R/S 247-1527
RESISTORS ¼W UNLESS SHOWN

FIGURE 5/7



Q1 AND Q2 BC108 or BC109

D1 AND D2 IN4148

FIGURE 6/7

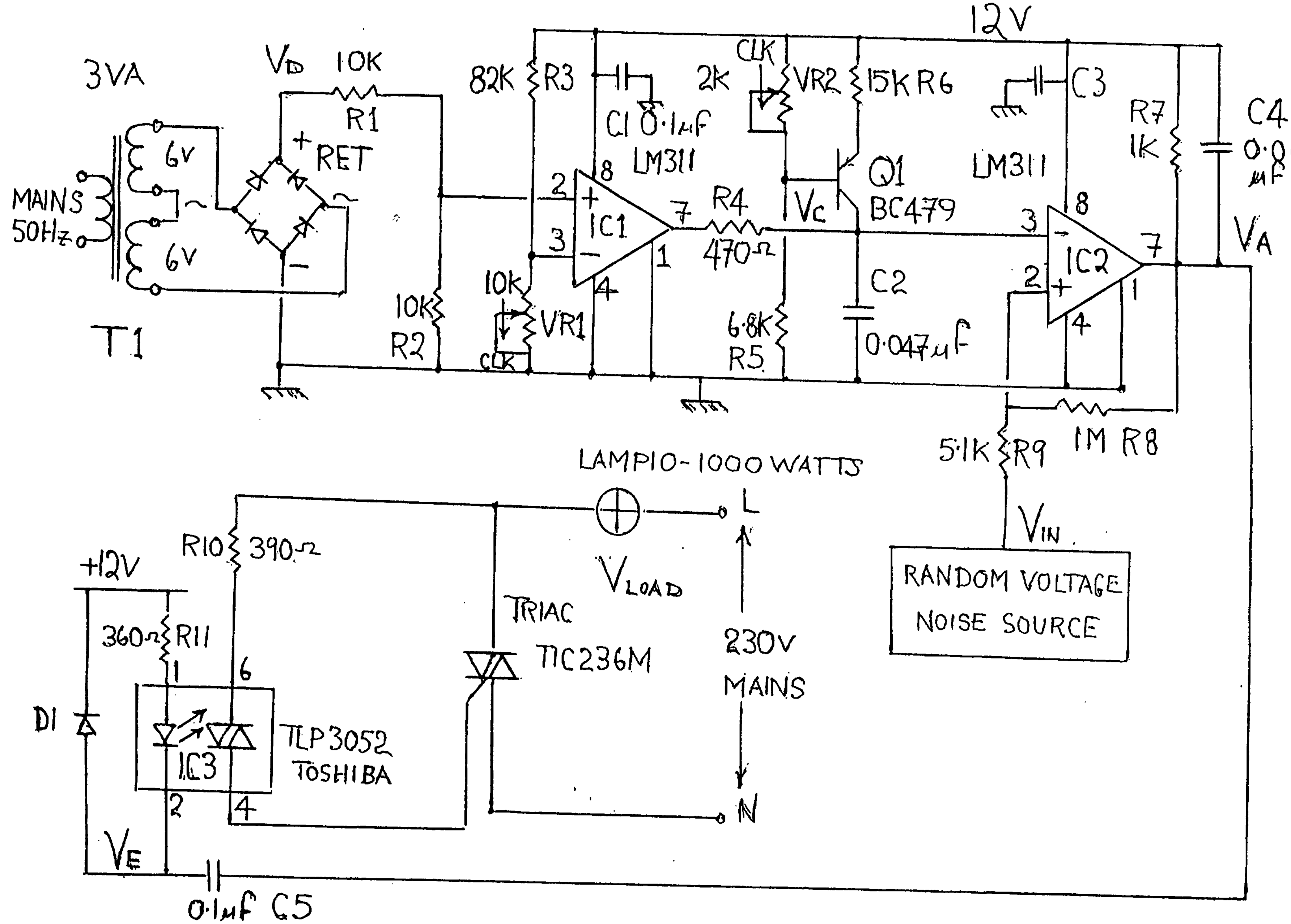
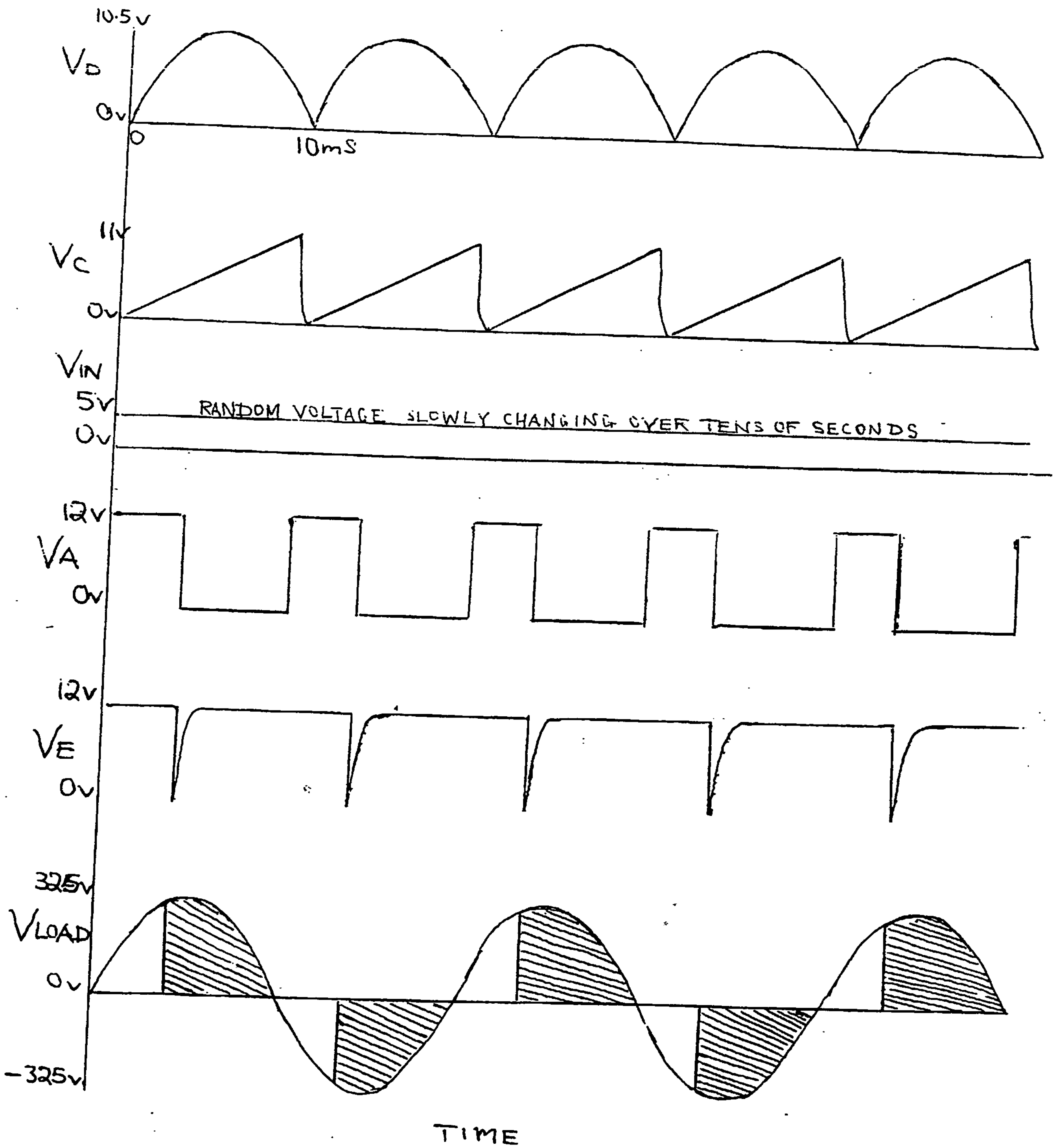

3VA
MAINS 50Hz
6V
6V
T1
V_D
10K
R1
+ RET
10K R2
82K R3
C1 0·1μF
LM311
IC1
10K
VR1
CLK
R4
470Ω
6·8K R5
2K
CLK
VR2
15K R6
Q1
BC479
V_C
C2
0·047μF
12V
C3
LM311
IC2
R7 1K
C4 0·01 μF
V_A
5·1K R9
1M R8
V_{IN}
RANDOM VOLTAGE NOISE SOURCE
LAMP10-1000 WATTS
L
N
V_{LOAD}
230V MAINS
TRIAC
TIC236M
R10 390Ω
+12V
360Ω R11
D1
IC3
TLP3052
TOSHIBA
V_E
0·1μF C5

FIGURE 7/7



10.5v
V_D
0v
0
10mS
11v
V_C
0v
V_{IN}
5v
RANDOM VOLTAGE SLOWLY CHANGING OVER TENS OF SECONDS
0v
12v
V_A
0v
12v
V_E
0v
325v
V_{LOAD}
0v
-325v
TIME

RANDOM COLOURED LIGHT GENERATION AND ILLUMINATION

This invention uses electronic circuitry see figures 3, 4, 5 and 6, to produce randomly changing voltages, red, green and blue light emitting diodes (RGB) LEDs and or incandescent or halogen lamps with coloured filters or lense, to create randomly slow or fast changing lights of all colours of the spectrum.

With the introduction commercially, of the blue LED at the beginning of the year 1999, along with the availability of existing red and green LEDs, this made available three light sources, red, green and blue, the three primary colours, easily controllable and relatively inexpensive.

This, along with reliable very slow or fast changing random voltage circuits derived digitally or from electronic noise circuits, came the idea of creating the three primary light sources independently changing in intensity, slowly or quickly, and randomly.

With these randomly slow or fast changing colours suitably mixed it would be possible to produce all colours of the spectrum and have applications in art, architecture, interior and exterior design and the creation of attractive and unusual artefacts.

A specific embodiment of the invention will be described by way of an example with reference to accompanying drawings: - figure 1 shows in perspective a stand 1, that can be made of a plated metal, plastic or wood, that houses a group of LEDs 10 figure 2 that emits light of the three primary colours red, green and blue. A globe or artefact 2, which can be a selected paper weight of clear glass, with a clear polished base, containing thousands of minute bubbles and or a filigree of small white particles to mix the light. A vase or glass cylinder filled with clear glass marbles at diameters of 10 millimetres or less creates a similar effect.

The enclosure 3 contains the electronic noise circuitry for generating the random voltage's to drive the LEDs. The lead from the LEDs is connected to the circuit enclosure 3 with five-pin plug and socket 5.

The power supply 4 is a 12V dc 500mA mains driven regulator which can be made or purchased as a ready made unit. The power supply is connected to the circuit enclosure 3 with a three-pin plug and socket 6.

Figure 2 shows the LED housing 7 which is seated, in the base 1. The housing 7, for the prototype, was made of Perspex fifty millimetres in diameter and ten millimetres thick, six ten millimetre holes 8 drilled as shown to hold and support the six LEDs 10. The four small 3 millimetre holes 9 are for anchor posts to act as junction points for the wiring 11 from the red, green and blue diodes, encapsulated in 10, and their common cathodes (or anodes).

The wooden base 1 and Perspex housing 7 can be scaled up or down depending on the availability of the glass spheres or artefacts and their dimensions and also depending on the efficiency of the artefacts to mix the three primary colours.

Each red, green and blue (RGB) LED 10 contain four LEDs one red, one green and two blue which together produce a rainbow of colours from a nearly single point light source.

Since the latter end of the year 2000 the light intensity and hue of the blue LED has improved considerably. Available from United States is a forty-five millimetre square compact matrix of 8x8, 64 discrete packages, set in a block of epoxy resin nine millimetre thick.

Each package houses three LED chips, red, green and blue acting as a near single-point light source, each with an epoxy lense diffused with tiny glass particles to mix and spread the coloured light. The area of this square unit is almost equal to that covered by the six diode-housing unit 7, but its light output is more than ten times as bright.

With this type of LED array there is not so much dependence on the availability of a particular artefact, their dimensions and their efficiency for mixing coloured lights.

To illuminate buildings powerful halogen lamps with their lenses covered with red, green and blue filters, would be required. Triac or thyristor interface circuitry to drive the lamps would be necessary as will be described and shown in figure 6.

The random voltage electronic circuitry that slowly and randomly drives the light sources can be used to drive stepper motor drive circuitry and their respective stepper motors to slowly and randomly rotate, turn and change the angle of illumination of the lamps.

To mix the red, green and blue light the inside and outside of buildings would be suitable treated or covered with fine particles of class (a use for the discarded ubiquitous compacted disc?)

Another architectural and artistic effect that can be created is with arrays of incandescent or halogen lamps, dimensionally small, 15-20 watts each. These lamps can be arranged in closely packed groups of three coloured lamps red, green, and blue. They could be coloured or coloured lenses or filters used. Placed over these arrays of groups of three coloured lamps would be sheets of opal or frosted glass to mix the colours.

Separate arrays of light, driven by separate random voltage circuitry, can be placed beneath garden paths made from glass bricks and patios paved in glass slabs, to create a kaleidoscopic range of slowly changing colours.

Clusters of (RGB) LED would be far more efficient and have a life span far exceeding that available from incandescent technology. But LEDs with a light output equivalent to an incandescent lamp are at present far more expensive.

Two types of electronic noise circuitry have been used to generate slowly changing random voltages.

The first circuit uses the avalanche breakdown noise from the reverse breakdown of a transistor's emitter-base diode. The other uses a digital technique consisting of a pair of shift registers two exclusive – OR gates and a clock generator.

Figure 3 shows the circuitry for the digital pseudo random bit sequence generator that generates sequences of bits that have same sort probability and correlation properties as an ideal coin-tossing machine.

Figure 3 shows the output bits of the shift-registers chosen to be filtered and drive the LEDs. The filter and drive circuitry for the red, green and blue LEDs are shown in figure 4.

Figure 3 shows the circuitry used to generate pseudo random bit sequences PRBS to create slowly changing random voltages.

The circuit consists of two CMOS 4006 18-stage shift registers IC1 and IC2 connected in series to give 36-stage shift register. To create a PRBS generator the 20th bit and 33rd bit of the shift registers are fed into the two inputs of exclusive – OR gate IC3/2, the reason for IC3/1 will be explained later. This modulo – 2 addition is then fed back into the input of the shift registers and the two registors slowly clocked by the CMOS 7240 programmable timer IC4.

The feedback taps 33 and 20 chosen for maximal – length shift registors are from a table of taps. See Horowitz and Hill, The Art of Electronics pp 655 – 661, where an explanation and derivation of the table is given.

Exclusive – OR gate IC3/1 along with capacitor C9 and resistor R1 ensure that always at switch-on a few 1s will be loaded into the registers.

The IC4 7240 timer acting as an oscillator produces a clock rate of approximately 0.1Hz. The shift register move through a set of states defined by the set of bits in the registers after each clock pulse. Using the feedback taps, stages 33 and 20 of the shift registers generates the longest pseudo random bit sequence possible from the 36-bit shift register.

The maximum number of conceivable states is $K=2^{33}-1$ eventually repeating itself after K clock pulses. With a clock rate of 0.1Hz K states, practically, would never be completed.

Another point to note, that in one sequence of K clock cycles there will be millions of groups of 'Os'and 'Is' half of which will be single 'Is', one fourth will be two 'Is' together, one eighth will be three 'Is' together and so on, in random order similar to the recorded results of heads and tails from the tosses of a fair coin.

Because of the very low clock frequency of 0.1 Hz from the oscillator IC4 there would be a long delay before the shift registers produced an output whenever the power was switched on.

To overcome this delay a 7555 timer IC5, acting as a mono-stable, is initiated each time the power is switched on, causing a 10 second pulse to be applied to the base of the transistor Q7. Q7 acts as a switch which decreases the timing resistor of the 7240 IC4 timer, by 30, resistor R2 in parallel with resistor R3, and speeding up some 30 times the bits passing through the register.

The other 7555 timer IC6, again acting as a mono-stable and triggered from the shift register IC2 output pin 9 via exclusive – OR gate IC3/3 wired as an inverter, is used solely to modify the overall mixture of the colours, in particular the blues, pinks and violets.

The string of pseudo random bits from the shift registers, rectangular pulses changing from zero to 12 volts and back, are applied to the filters IC7 and IC8 shown in figure 4.

The filters, third-order Butterworth having a 3dB cut-off of approximately 0.01Hz are used to give the desired slow rounded rise and fall times to give the most pleasing colour lighting effect from the driven (RGB) LEDs.

Each group of LEDs are voltage driven by a pair of transistors a BC109 and a BD131, acting as a Darlington pair. The final drive power transistor BD131 and the 2 watt-emitter resistor can be adjusted to drive as many LEDs as required.

The pseudo random bit sequence generator is easy to assemble with no special technical requirements. The circuit is reliable and repeatable.

The second type of electronic noise circuit shown in figure 5, used to generate slowly changing random voltages, makes use of the reverse avalanche breakdown voltage of a transistor's emitter base diode Q1. Three circuits, shown in figure 5, are required to drive the three sets of coloured LEDs.

The transistor amplifier Q2 using collector feedback resistor R2 and capacitor C1 amplifies and enhances the noise voltage appearing at the collector of Q2. The Q2 emitter resistor R3 and the collector feedback resistor R2 stabilise the dc voltage at the collector and base of Q2 and the noise current fed into its base. It also helps to stabilise the average noise voltage amplitude at the collector at Q2.

The noise voltage is capacitively coupled by C2 to the 10K potentiometer VR1. The noise voltage at the wiper of VR1 is again capacitively coupled by C6 to the variable potential divider consisting of resistor R7 and resistor R12 connected in parallel with the n-channel JFET Q3 which will be explained later. The junction at the divider is connected to pin 3 of the ac amplifier IC1. The noise voltage at pin 3 in amplified by IC1, a non-inverting operational amplifier, with a maximum gain of 200 set by the resistors R8 and R6.

For simplicity and to make the circuit less expensive it is driven from a single supply of 12 volts. The two non-inverting operational amplifiers IC1 and IC4, the populor 741s, are operated from a split supply. A 6 volts reference is generated by the potential divider formed by the 10K resistors R4 and R5. Capacitor C3 is placed across R5 for de-coupling any noise on the 6-volt reference supply.

To block the 6 volt dc levels that exist at the inputs and outputs of the non-inverting operational amplifiers IC1 and IC4, capacitive coupling has been used, namely C4, C6, C7, C11, C13 and C14.

To maintain the repeatability of the circuit and maintain strict noise voltage amplitude control and long term stability at the output of the amplifier IC1 whatever transistor noise source Q1 had been selected, AGC, automatic gain control of amplifier IC1 has been employed.

The AGC is provided by the non-inverting amplifier IC4 which has a maximum gain of five, set by resistors R14 and R15. The input pin 3 of amplifier IC4 is connected to potential divider resistor R16 and variable resistor VR3 which is fed with amplified noise from the output of amplifier IC1 via a capacitor C11.

The output of amplifier IC4 is capacitively couple by C14 to a rectifying and smoothing circuit. The rectifying circuit consists of diodes D1 and D2 and smoothing circuit resistor R13 and capacitor C15.

The rectified and smoothed voltage V_G is applied to the gate of JFET Q3. The JFET Q3, along with resistor R12 connected to the drain and source at Q3, and resistor R7 form a variable potential divider, as mentioned earlier, which is connected to the noise voltage source, and completes the AGC loop.

It should be noted that since the source terminal of JFET Q3 is connected to the 6 volt reference supply and the drain terminal of Q3 is connected to pin 3 at the amplifier IC1 which is also at 6 volts, there is virtually zero dc volts between drain and source of Q3. This creates the conditions for the JFET to become a variable resistor in parallel with the 20K resistor R12. Also note, that because there is virtually no dc drain current through the JFET Q3 variable resistance control for the ac noise voltage is always achieved within millivolts of V_T (the threshold voltage gate to source voltage V_{GS} at which drain current begins to flow). This V_T, which is equal to, 6 volts minus V_G, where V_G is the voltage monitored at the gate of Q3 with respect to ground with an oscilloscope and or with a digital voltmeter. This is part of the adjustment procedure explained later

The threshold voltage V_T of the n-channel JFET J112, used in the circuit, has a manufacturing spread of minus 1 volt to minus 5 volts, which is accommodated by the AGC circuit.

The set up or adjustment procedure for a stable noise voltage amplitude from the output at amplifier IC1 pin 6 is to monitor the peak to peak noise voltage of the wiper at the potentiometer VR1 with an oscilloscope. Adjust VR1 for a peak to peak voltage amplitude of between 200 to 800 millivolts. Monitor the voltage V_G on the gate terminal of the JFET Q3 with an oscilloscope or digital voltmeter with respect to ground. Adjust the variable resistance VR3 and observe V_G, which should remain fixed or increase with the increase of resistance VR3. When V_G reaches a fixed value this indicates the threshold voltage V_T has been reached and the AGC is operating.

Monitor the output of amplifier IC1 with an oscilloscope and again adjust VR1 and VR3, maintaining V_G at the gate terminal of Q3 fixed with VR3, until the noise voltage is within 700 to 1000 millivolts peak to peak.

The stabilised or controlled noise voltage appearing at pin 6 of amplifier IC1 is capacitvely coupled by C7 to pin 3 of the general purpose comparator LM311 IC2. Pin 3 of IC2 is referenced to ground by resistor R10. The noise voltage at pin 3 is compared with pin 2, the dc voltage from potentiometer VR2 the wiper of which is de-coupled to ground with capacitor C8.

The output from the comparator is taken from pin 1. Pin 1 is part of the emitter of an internal transistor and pin 7 is connected to the collector and is taken to the 12-volt supply. Pin 1 is connected to ground by resistor R11.

The output at pin 1 switches to 12 volts whenever the random noise voltage at pin 3 exceeds the set dc voltage on pin 2 and back to zero voltage whenever the noise peaks fall below the set dc voltage.
This causes a series of rectangular pulses with random off-and-on interval at the output of IC2.

To achieve a frequency count of approximately 10 on and off random intervals every 20 to 25 second the dc voltage at pin 2 is adjusted to be compared with larger and less frequent varying random noise voltage peaks at input pin 3.

Very narrow pulses that may occur are eliminated by the filtering effect of the capacitor C10 across resistor R11.

To achieve the final ideal drive to the LEDs or light source to create the most pleasing effect for slowly changing colours the series of rectangular pulses with random on and off intervals must be even slower. Six on off cycles approximately every 110 seconds. To achieve this the output from the comparator IC2 pin 1 is fed into pin 1 of the CMOS binary counter 4024 IC3.

After three divisions by 2, divide by 8, the output from pin 9 is fed into its corresponding filter shown in figure 4.

It should be noted there is a limit to the number of divisions that can be made. For example the mean period increases by 2 at each division. Whereas the deviation from the mean expressed by the standard deviation increases proportionally as the square root of the mean period. So that the coefficient of variation: -

$$\frac{\text{standard deviation}}{\text{mean}}$$

decreases rapidly. Meaning, after many division there is very little deviation from the compared mean value of the final output waveform and it appears as a square wave.

It should also be noted that the three random noise voltages produced by the three transistor noise circuits are discrete. The random noise voltages produced by the pseudo random generators are not discrete, but this does not cause any difference to the overall random colour effect.

The circuit was built and developed to be repeatable and to eliminate the necessity of having to select the noise transistor Q1 and the JFET Q3.

Figure 6 shows a triac phase control circuit used to drive more powerful light sources such as halogen and incandescent lamps. T1 is a small 3VA 230v mains transformer with its two 6 volt secondary windings connected in series to produce 12 volts r.m.s. The transformer secondary voltage is not critical but 10 volts r.m.s or more is preferable.

The 12 volts r.m.s. secondary voltage is full wave rectified, V_D figure 7, by the bridge rectifier RET.

The full wave rectified voltage V_D is halved by potential divider resistors R1 and R2 and compared, with a fixed voltage set by resistor R3 and variable resistor VR1, at the inputs pin 2 and pin 3 to voltage comparator LM311 IC1. The comparator IC1 acts as an on-off trigger for the ramp voltage generator, V_C figure 7, consisting of transistor Q1 capacitor C2 variable resistor VR2 and resistor R5.

The full-wave rectified voltage V_D also acts as a mains reference for the control for the delayed triggering of the triac T1C236M from each zero potential cross over point of the ac mains voltage across the load, V_{LOAD} figure 7.

Variable resistor VR1 adjusts the start and finish of the ramp voltage V_C from approximately 0.45 milliseconds or less after each zero cross over point of the ac mains voltage wave form and 0.45 milliseconds or less before.

The ramp generator consists of a constant current generator formed by transistor Q1, variable resistor VR2 and resistor R5. VR2 adjust the current supplied by the constant current generator used to change up capacitor C2 to form the voltage ramp waveform V_C figure 7.

At intervals of slightly less than ten milliseconds the capacitor C2 ramps from approximately zero to 11 volts and is discharged at the end of each mains voltage half cycle via resistor R4 by the IC1 comparators' internal transistor switch accessed at pin 7 and 1.

The ramp potential V_C appearing across the capacitor C2 is applied to pin 3 of the second voltage comparator (LM311) IC2 where it is compared with the random voltage V_{IN} at pin 2, V_{IN} is the output of one of the filters shown in figure 4.

Because of the slow changing nature of the random voltage V_{IN}, positive feedback is provided for comparator IC2 by resistors R8 and R9 to eliminate false triggering.

Resistor R7 connected to pin 7 at the comparator IC2 is a pull-up resistor connected to the comparator's transistor open collector.

Each time the voltage V_C at pin 3 of the comparator IC2 exceeds the slowly varying random voltage V_{IN} at pin 2 of IC2 the output voltage V_A at pin 7 drops rapidly from 12 volts to nearly zero volts, which is turned into a negative going differentiated pulse V_E, figure 7, by the capacitor C5 and applied to pin 2 of IC3 and the catching diode D1 (IC3 in an optically coupled bilateral switch, TLP3052 to isolate the mains voltage from the low voltage circuitry).

The negative going differentiated pulse V_E triggers the bilateral switch IC3 which in turn triggers 12 Amp triac T1C236M on to full conduction. The triac will then continue to conduct until the 230 mains voltage drops to the zero cross-over point in its half-cycle.

Before this zero point is reached and dependant on the voltage level of the ramp voltage V_C with respect to the random voltage V_{IN}, the comparator IC2 output V_A will switch back rapidly to 12 volts once V_C nearly equals the random voltage V_{IN}.

This 12-volt step is again differentiated by C5 but this positive going pulse is allowed to pass through diode D1 to the 12V supply without any effect on the input to IC3.

The cycle is repeated every ten milliseconds as shown in figure 7.

The circuit has been constructed and developed and powered-up to drive lamps for many hours and has proved reliable and repeatable.

CLAIMS

1. The application of random light sources, consisting of the three primary colours red, green and blue, comprising of incandescent or halogen lamps or clusters of red, green and blue light emitting diodes (RGB) LEDs. The intensity of the light sources fractions of a watt to tens of kilowatts, and each coloured light source independently driven by circuitry to change its intensity RANDOMLY, slowly or quickly for applications in art,architecture, interior and exterior design and the creation of unusual artefacts.

2. The application of random coloured light sources to unusual artefacts as claimed in claim 1. The slow random coloured under-lighting, as shown in figure 1/7, of selected paperweights of clear glass, clear glass and plastic artefacts, with colour mixing properties. The under or internal slow random coloured lighting of clear glass vases or cylinders filled with clear glass marbles or beads of ten millimetres or less. The applications to table lamps of random coloured light consisting of white opal glass spheres or cylinders of milk white glass or plastic or other geometrical shapes internally lit with three incandescent lamps coloured or filtered red, green and blue and or with cluster of (RGB) LEDs, each light source independently slowly and randomly changing in intensity to create all colours of the spectrum.

3. The application of random coloured lights to art as claimed in claim 1 or claim 2. The arrangement of rectangular, plolygonal and circular arrays of (RGB) LEDs, set in picture frames or recessed into walls, each array masked from the other behind opal or milk-white glass each array independently slowly and randomly driven to produce a never ending kaleidoscopic abstract picture of colours and shapes.

   The use of slow and fast coloured random light sources to create artistic effects by use of prisms, mirrors, lenses, sculptured and moulded glass.

4. The application of random coloured lighting to architecture as claimed in claim 1. The application of three slow random coloured light sources using powerful halogen lamps with their lenses covered with red, green and blue filters to illuminate the exterior of buildings, specially prepared structures, arches and monuments, water features and fountains. The use of random voltages to drive stepper motors to slowly and randomly tilt and turn the coloured lights.

5. The application of random coloured light to interior and exterior design as claimed in claim 1 and claim 4. The use of groups of three coloured incandescent lamps and or (RGB) LEDs arranged in arrays, covered with opal or milk white glass or plastic to mix the colours.

   These arrays driven by separate slow changing random voltage circuitry to be used to create colourful effects in parks, gardens and leisure centres, by placing the arrays beneath paths made from glass bricks and slabs to create a kaleidoscopic range of slowly changing colours.

CLAIMS

The use of slow changing random coloured lighting to illuminate shrubbery and trees, the colours suitably modified to two colours, for example, a mixture of green and blues for the trees.

The use of slow random coloured lighting in hotel foyers, entrances and lobbies to public and private buildings, by illuminating colour-mixing silk drapery or curtains hung in folds. The slow random colour illumination of interior walls treated with fine particles of clear glass to mix the light.

The use of slow random coloured lighting under floors around the perimeters of halls, rooms and lobbies to illuminate walls and enhance architectural features. The use of random illumination for swimming pools and leisure centres.

Amendments to the claims have been filed as follows

1) An apparatus comprising red, blue and green light sources, electronic circuitry for, in use, controlling the intensity of each light sources randomly and independently, a housing in which the light sources are held, and substantially solid or filled, substantially spherical or other geometrical shaped cover which allows light to be mixed and pass from the light source to the surrounding environment.

2) An apparatus as claimed in claim 1 wherein the variation of the light intensities and corresponding periods are totally independent and are continuously random and have the same probability and correlation properties as an ideal coin-tossing machine.

3) An apparatus as claimed in claims 1 and 2 wherein the electronic circuitry shown in figure 6/7 can be additionally used to drive light sources of any power continuously random to allow light to pass through housings of different sizes, geometries and colour mixing properties to the surrounding environment.

4) An apparatus as claimed in claims 1 and 3 wherein the substantially solid or filled substantially spherical or other geometrical shaped cover has a plurality of bubbles.

5) An apparatus as claimed in claims 1 and 3 wherein substantially solid or filled substantially spherical or other geometrical shaped cover has a filigree of white particles.

6) An apparatus as claimed in claim 1 and 3 wherein the substantially solid or filled substantially spherical or other geometrical shape or cover is a hollow shell filled with glass marbles.

7) An apparatus according to any preceding claim where the housing is, in use, randomly moved by motors driv n by the outputs of the el ctronic circuits.

12

INVESTOR IN PEOPLE

Application No:	GB 0103511.2	**Examiner:**	Andrew Hole
Claims searched:	1	**Date of search:**	12 September 2001

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.S): F4R (RFC, RFG); G5C (CDBK, CDBX)

Int Cl (Ed.7): F21K 7/00; F21V 9/10

Other: Online: WPI, EPODOC, PAJ

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
A	EP 0822371 A2	(HIYOSHI) See Figures.	
Y	WO 99/13693 A1	(MALBEC) See Figure and front page English Abstract.	4 & 5.
X, Y	US 3789211 A	(KRAMER) See Figures 3 & 5 especially, and column 3, line 19 to column 5, line 2.	X: 1. Y: 4 & 5.

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.